

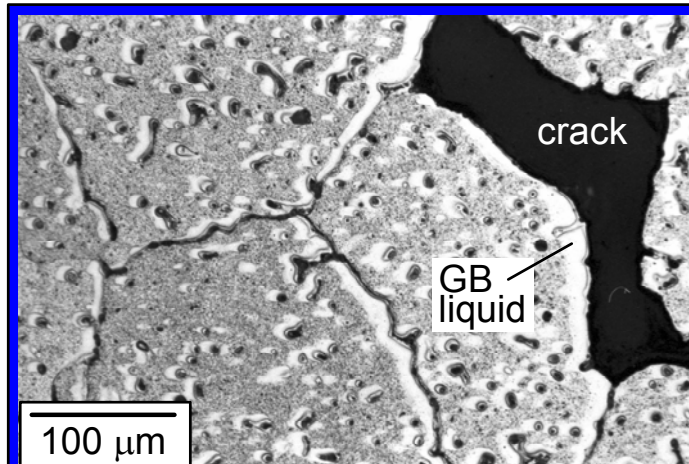
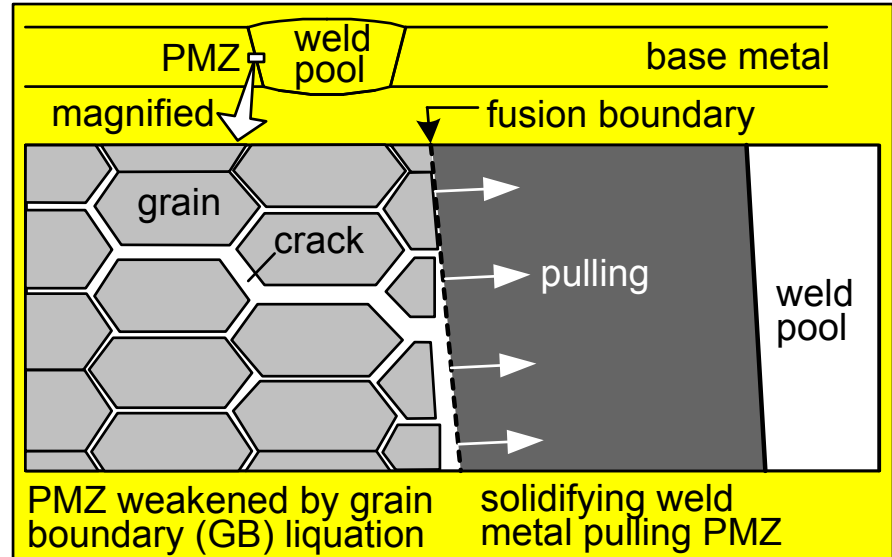
Partially Melted Zone (PMZ) Cracking in Aluminum Welds

Sindo Kou, University of Wisconsin, DMR-0098776

PMZ (liquation) Cracking Mechanism:

- PMZ, immediately outside the weld where grain boundary melting occurs during welding, cracks when the solidifying weld metal contracts and pulls.
- Most aluminum alloys are susceptible to PMZ cracking in welding.
- Important for automobile industry to make sound aluminum welds in body structures.

1. C. Huang and S. Kou, "Liquation Mechanisms in Multi-component Aluminum Alloys during Welding," Welding Journal, accepted.
2. C. Huang and S. Kou, "Mechanism of Liquation Cracking in Aluminum Alloys: Full-Penetration Welds," Welding Journal, submitted.



PMZ of
6061
aluminum

The PMZ is immediately outside the weld, and it is overheated during welding - to between the eutectic temperature and the liquidus temperature of the workpiece. This causes melting along grain boundaries as well as at isolated spots in the grain interior (See the micrograph above). Many aluminum alloys are susceptible to PMZ cracking because of the wide PMZ and the significant contraction of the solidifying weld metal. The wide PMZ is due to the wide freezing temperature range and high thermal conductivity of aluminum alloys. The significant contraction is due to the significantly higher (6.6%) density of solid aluminum than liquid aluminum and the large thermal expansion coefficient of aluminum. Welding of aluminum alloys is important to the automobile industry because of the increasing use of welded aluminum body structures.

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Training:

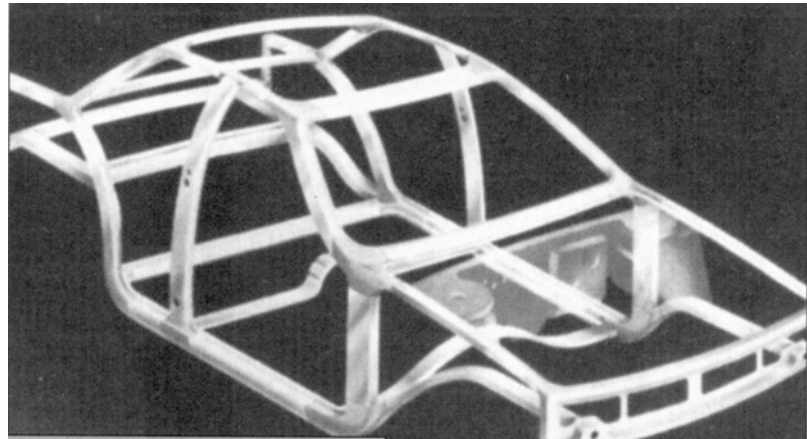
- 2 graduate students (C. Huang and G. Cao) have participated in research.
- 1 undergraduate student has participated in research.

Outreach:

- Communicated with Miller Electric Manufacturing Company, Appleton, WI, 2002 (biggest welding equipment manufacturer in US).
- Communicated with General Motors Research and Development, Warren, MI, 2002.

TECH SPOTLIGHT

Arc welding automotive aluminum



From Advanced Materials & Processes, September, 2001

The following paper from DMR-9803589 (previous award with no cost extension to July 2002) received Charles H. Jennings Memorial Award, American Welding Society, 2002 for being the most valuable paper published in *Welding Journal* in 2001:

C. Huang, and S. Kou, “Partially Melted Zone in Aluminum Welds – Solute Segregation and Mechanical Behavior,” *Welding Journal*, vol. 80, 2001, p. 9-s.